precautions to prevent experimental errors are often given in considerable detail, as, for example, in regard to freezing-point determinations and conductivity measurements; yet if this be the intention of these descriptions they are singularly incomplete in other respects. For example, in describing the determination of the freezing point the only thing said about the thermometer to be used is that it may have either a fixed or a variable zero. We venture to think that some description of the Beckmann thermometer and the method of using it would have been of service here.

BENJAMIN MOORE.

THE MAKING OF ROCKS.

Petrogenesis. By Dr. C. Doelter. Pp. xii+262. (Brunswick: Vieweg und Sohn, 1906.) Price 7 marks.

IN this work, which would be valued highly for its references to current literature alone, the author brings together what is known as to the origin of various types of rocks. Its outlook is that of the mineralogist and not of the physical geographer; but this enables the author, though far too modestly, to bring his researches on the construction of minerals and rocks to bear upon broad geological problems. As a treatise, the book is elementary and yet satisfying; in the series of which it forms a part, "Sammlung naturwissenschaftlicher und mathematischer Monographien," it exactly fills its place as an exposition of prevalent, if not necessarily established, views. Very often these views are subjected to criticism that shows how far we are from finality and conclusions; but the lucidity of discussion and absence of bias displayed by Dr. Doelter make us grateful to him as a guide. The history of the struggle for the Rhine in no way affects his scientific judgment; and once again we feel that Austria holds the balance in the geological controversies of our time.

When we say that the book is elementary, we mean this in the best of senses. It goes to the root of a question, and compels the reader to understand it. As an example of the large amount of valuable matter that may be compressed into one paragraph, we may take the following (p. 80), from a discussion on differentiation in igneous magmas:—

> "Attempts have been made, as we have seen, to connect differentiation fundamentally with the existence of magmas which will not mix with one another. But this is an improbable supposition, since every magma can dissolve any other, as I have shown experimentally. The solubility of one mineral in another depends only on the temperature; and at a temperature varying with each case, the critical temperature of solution, the products of fusion are soluble in one another. Experiment also proves to us that no separation takes place in the fluids so long as they are stirred; it occurs first as cooling goes on; where there is no movement, separation can take place according to specific gravity, even in the fluid state."

The book opens with a discussion of the causes of fluidity of magmas within the earth, and their occasional appearance at the surface is attributed primarily to tectonic movements. When relief from pressure comes, the magma becomes fluid, and corrodes the surrounding rocks. The gases contained in it operate "like a blowpipe-flame." The results of such corrosion are treated later (p. 116, &c.), and Dr. Doelter remarks, following Daly's recent papers, that basic lavas, coming quickly up broad cracks, reach us in a state of greater purity than acid ones, which move more slowly, and have greater opportunities for affecting the walls that bound them. The acid masses "exhibit traces of the country-rocks, but not necessarily near the contact-zone, since, in the case of deep-seated rocks, the absorbed fragments may become distributed in the interior of the mass."

The author's remarks on the potency of mineralising agents during the consolidation of igneous rocks are based upon his own well-known experiments. Mica thus seems always to require the presence of fluorine. While water is the greatest mineraliser, we are reminded that we are not dealing with pure water in the earth, but with water containing chlorides, hydrochloric acid, boric acid, and so forth (p. 24). Certain minerals decompose in their own products of fusion, and give rise to other minerals, or mere glass, on consolidation. In such cases, the crystalline condition remains stable only at a lower temperature than that of fusion, and the function of a mineraliser or "crystalliser" is to reduce the temperature at which the substance crystallises out again. If the right point is reached, the original mineral is recovered in its crystalline form. Thus, in the much-debated case of quartz, the mineral, at ordinary pressure, will not separate from its product of fusion at temperatures above 950°. Below this temperature its crystals are stable. Above it they are unstable, although their melting-point is not reached until 1600° or 1700°. The common minerals that require the help of mineralisers for their formation are albite, orthoclase, quartz, garnet, haüyne, epidote, wollastonite, hornblende, and mica. Hence an acid crystalline rock cannot arise without mineralisers, and the frequent presence of tourmaline, fluorspar, scheelite, and so forth, in granite, indicating boric acid, fluorine, tungstic acid, chlorides, &c., bears out in nature the results of synthetic laboratory work.

On p. 65 it is interestingly pointed out that the different items in the chemical analysis of a rock, as written down, possess very different values, and that too large deductions must not be based on small differences in the quantities of magnesia, soda, or potash stated to be present. Exactitude in these determinations is not obtainable with the same degree of success as in the case of silica and alumina, and the alkalies, unfortunately, usually appear as small numbers, in which the second place of decimals becomes of importance for comparison. The American school, by the by, has made such headway that the word "salisch" slips in naturally on p. 44.

We cannot dwell on all the important considerations here put forward as to the processes that go on during the cooling of igneous rocks. Among these, the description of "Unterkühlung" on p. 137 strikes us as of especial interest. The retention of

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a mineral in a state of fusion below its ordinary melting-point may allow of the previous crystallisation of another, which cannot sustain such conditions, and thus the normal order of crystallisation may be reversed. This fact is used to explain the crystallisation of augite before the felspar in basic rocks, which, in normal circumstances, so frequently show ophitic structure.

All through the book the influence of personal experiment remains manifest, and we must not complain if the genesis of the sedimentary rocks is treated in a somewhat rapid fashion. Flints thus receive far less than their due (p. 232), considering how much they have been discussed. Guppy's observations on silicified corals in the Fiji Islands raise, for instance, new questions in themselves. But references to recent work, such as Linck's on the separation of calcium carbonate from sea-water, will lead the reader forward; and we turn back contentedly from these scantier pages to the fine account of the problems of contact-metamorphism, and thank the author again and again for his clear and stimulating treatise.

As is natural in so wide a field, we miss mention of some memorable work, such as that of Harker on mixed rocks in the Inner Hebrides; on the other hand, we hail with delight the name of MacGregory (p. 31), who appears to be Prof. J. W. Gregory in the glory of a Scottish title.

GRENVILLE A. J. COLE.

STRUCTURES AND MATERIALS.

Theory of Structures and Strength of Materials. By Prof. Henry T. Bovey. Fourth edition. Pp. xiii+968. (New York: John Wiley and Sons; London: Chapman and Hall, 1905.) Price 1*l.* 11*s.* 6*d.* net.

THIS well-known text-book has been largely rewritten and enlarged for the present fourth edition. In the preface Prof. Bovey states that a number of fresh examples, mostly drawn from actual practice, have been added to the various chapters, and that all tables of strengths, elasticities, and weights of materials have been brought up to date.

In chap. i. a description of Bow's method of notation is given, and the author has now adopted this system throughout the book when dealing with stresses developed in framed structures. The treatment of the three-hinged braced arch for station roofs and for sheds of wide span is a new piece of work in this chapter. In chap. ii. there is a new series of paragraphs dealing with the graphical determination of the maximum bending moment at any point of an arbitrarily loaded girder, and several examples illustrating the author's methods are worked out in full. Chap. iii. of the older editions has wisely been broken up into two chapters, one (chap. iii.) dealing with momentum, energy, and balancing, and the other (chap. iv.) with stress, strain, and elasticity. In the older editions this chapter was a very difficult one for the student to follow, and the author, in rewriting and dividing it, has brought the various steps of the work into their true relation one with the other. The whole of the material in chap. x. of the older editions, which dealt with thick-walled, hollow cylinders, has now been incorporated into chap. v., which treats of the more difficult work on stress and strain, and undoubtedly it follows more naturally in this position after the discussion of the general equations of stress.

In chap. vii., in dealing with the relation of the neutral plane to the stress at any point in a beam, Prof. Bovey has incorporated the results of his own experimental work, which was carried out with the view of determining within the limits of elasticity the changes of fibre length at different depths of a beam when loaded transversely. In this chapter there are also additional paragraphs dealing with the design of reinforced concrete beams, the position of the neutral axis, and the strength of such beams; additional graphical methods are given for determining the slope and deflection in loaded beams, and in connection with the theory of continuous girders fresh matter has been introduced.

In chap. viii., which deals with the theory and the bending of struts, the results of the most recent experiments have been incorporated, and, as the chapter has been rearranged, it is now much more useful to engineers engaged in the difficult problem of strut design. In chap. ix. the stresses in non-circular shafts are discussed, and there is also much new matter in the paragraphs on the efficiency of shafting and the whirling of shafting, and open coil springs are dealt with, as well as the ordinary helical springs. Chap. x., which is devoted to bridges, has been entirely rewritten and greatly improved. Graphical methods are used throughout for the determination of stresses in the piers, and the most recent types of bridges are discussed and explained. Excellent tables are given of the loads upon, and the weights of, bridges, and several examples of fairly large bridges are worked out in complete detail. This chapter is now a most valuable one for those who are concerned with the design of bridges of all classes, and the examples have been made thoroughly practical. We have no hesitation in saying that Prof. Bovey in thus practically rewriting his book has considerably improved its value both to the engineering student and to the civil engineer engaged in the design of all classes of structures in steel and iron.

T. H. B.

RATIONAL DAIRYING.

Dairy Chemistry. By Harry Snyder. Pp. x+190. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1906.) Price 4*s.* 6*d.* net.

PROF. SNYDER'S work as agricultural chemist in the University of Minnesota is well known. This State, with a population less than that of Kent and Essex, possesses a University Agricultural Department in which are 800 students most of whom are attending a three years' course. The majority are students who during the summer months have to work for a living, and at the close of their academic training return to rural employment. Thus Min-

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